

CLAIMS:

- 1 1. A semiconductor processing system comprising:  
2 a) a pod loader;  
3 b) a transfer robot;  
4 c) a load lock comprising:  
5 i) a chamber; and  
6 ii) a load lock robot disposed in the chamber; and  
7 d) a process chamber.
- 1 2. The system of claim 1 wherein the load lock further comprises:  
2 a) a bottom having one or more perforations; and  
3 b) one or more lift pins slidably disposed through the one or more  
4 perforations.
- 1 3. The system of claim 2 wherein the lift pins are coupled at one end to a linear  
2 actuator.
- 1 4. The system of claim 1 wherein the load lock further comprises a vacuum pump.
- 1 5. The system of claim 4 wherein the vacuum pump is in fluid communication  
2 with the chamber.
- 1 6. The system of claim 1 wherein the load lock further comprises an elongated  
2 substantially rectangular aperture.
- 1 7. The system of claim 6 wherein the load lock further comprises a hermetic  
2 sealing apparatus adapted to substantially cover the aperture.
- 1 8. The system of claim 7 wherein the hermetic sealing apparatus comprises a slit  
2 valve.

1 9. The system of claim 7 wherein the hermetic sealing apparatus comprises a gate  
2 valve.

1 10. The system of claim 1 wherein the load lock further comprises:  
2 a) a cover defining an opening; and  
3 b) a lid adapted to substantially cover the opening.

1 11. The system of claim 10 wherein the lid further comprises at least one  
2 stabilizing rod disposed through the lid and connected to the cover.

1 12. The system of claim 10 further comprising a transfer assembly adapted to  
2 transfer one or more objects to a plurality of positions.

1 13. The system of claim 12 wherein the transfer assembly comprises:  
2 a) two pairs of rotational and vertically slidable lifting members each pair  
3 being disposed through a pair of bores formed vertically through the lid;  
4 b) a wafer lifting element attached to each lifting member at a first end; and  
5 c) one or more actuators attached to each pair of lifting members at a  
6 second end.

1 14. The system of claim 13 wherein the one or more actuators impart vertical and  
2 rotational movement to each lifting member.

1 15. The system of claim 13 wherein each pair of lifting members cooperate to  
2 transfer an object to a plurality of positions.

1 16. The system of claim 1 wherein the load lock robot comprises:  
2 a) a symmetrical linkage assembly comprising  
3 i) a first drive arm having a first end and a second end, the first  
4 drive arm being rotatable about a first axis at its first end;  
5 ii) a second drive arm having a first end and second end, the second  
6 drive arm being rotatable about a second axis at its first end, the first and second drive  
7 arms being separated by a distance greater than a wafer diameter in their extended  
8 positions such that a wafer may be vertically transferred between the drive arms;  
9 iii) a first strut that is connected to the first drive arm at a first pivot  
10 joint; and  
11 iv) a second strut that is connected to the second drive arm at a  
12 second pivot joint, the first and second pivot joints defining a lagging axis; and  
13 b) a blade pivotally connected to the first strut at a first wrist joint and the  
14 second strut at a second wrist joint, the first and second wrist joints defining a leading  
15 axis which remains constantly parallel to, and horizontally displaced from, the lagging  
16 axis .

1 17. The system of claim 16 wherein the blade is extended by the simultaneous and  
2 synchronous clockwise rotation of the first drive arm and counterclockwise rotation of  
3 the second drive arm.

1 18. The system of claim 16 wherein the blade is retracted by the simultaneous and  
2 synchronous counterclockwise rotation of the first drive arm and clockwise rotation of  
3 the second drive arm.

1 19. The system of claim 1 wherein the load lock is connected to the process  
2 chamber.

- 1 20. A load lock comprising:  
2 a) a chamber;  
3 b) a load lock robot disposed in the chamber; and  
4 c) a process chamber attached to the chamber.
- 1 21. The apparatus of claim 20 wherein the load lock further comprises:  
2 a) a bottom having one or more perforations; and  
3 b) one or more lift pins slidably disposed through the perforations.
- 1 22. The apparatus of claim 21 wherein the lift pins are coupled at one end to a linear  
2 actuator.
- 1 23. The apparatus of claim 20 wherein the load lock further comprises a vacuum  
2 pump.
- 1 24. The apparatus of claim 23 wherein the vacuum pump is in fluid communication  
2 with the chamber.
- 1 25. The apparatus of claim 20 wherein the load lock further comprises an elongated  
2 substantially rectangular aperture providing for fluid communication between the  
3 chamber and the process chamber.
- 1 26. The apparatus of claim 25 wherein the load lock further comprises a hermetic  
2 sealing apparatus adapted to substantially cover the aperture.
- 1 27. The apparatus of claim 26 wherein the sealing apparatus is a slit valve.
- 1 28. The apparatus of claim 26 wherein the sealing apparatus is a gate valve.

1 29. The apparatus of claim 20 wherein the load lock further comprises:

- 2 a) a cover defining an opening; and  
3 b) a lid adapted to substantially cover the opening.

1 30. The apparatus of claim 29 further comprising a transfer assembly adapted to  
2 transfer one or more objects to a plurality of positions.

1 31. The system of claim 30 wherein the transfer assembly comprises:

- 2 a) two pairs of rotational and vertically slidable lifting members each pair  
3 being disposed through a pair of bores formed vertically through the lid;  
4 b) a wafer lifting element attached to each lifting member at a first end; and  
5 c) one or more actuators attached to each pair of lifting members at a  
6 second end.

1 32. The system of claim 31 wherein the one or more actuators impart vertical and  
2 rotational movement to each lifting member.

1 33. The system of claim 31 wherein each pair of lifting members cooperate to  
2 transfer an object to a plurality of positions.

1 34. The apparatus of claim 20 wherein the load lock robot comprises:

- 2 a) a symmetrical linkage assembly comprising  
3 i) a first drive arm having a first end and a second end, the first  
4 drive arm being rotatable about a first axis at its first end;  
5 ii) a second drive arm having a first end and second end, the second  
6 drive arm being rotatable about a second axis at its first end, the first and second drive  
7 arms being separated by a distance greater than a wafer diameter in their extended  
8 positions such that a wafer may be vertically transferred between the drive arms;  
9 iii) a first strut that is connected to the first drive arm at a first pivot  
10 joint; and

- 11                   iv)     a second strut that is connected to the second drive arm at a  
12 second pivot joint, the first and second pivot joints defining a lagging axis; and  
13                   b)     a blade pivotally connected to the first strut at a first wrist joint and the  
14 second strut at a second wrist joint, the first and second wrist joints defining a leading  
15 axis which remains constantly parallel to, and horizontally displaced from, the lagging  
16 axis .

1   35.     The apparatus of claim 34 wherein the blade is extended by the simultaneous  
2 and synchronous clockwise rotation of the first drive arm and counterclockwise rotation  
3 of the second drive arm.

1   36.     The apparatus of claim 34 wherein the blade is retracted by the simultaneous  
2 and synchronous counterclockwise rotation of the first drive arm and clockwise rotation  
3 of the second drive arm.

1   37.     An apparatus for transferring objects between a first position and a second  
2 position comprising:

- 3                   a)     a symmetrical linkage assembly comprising  
4                         i)     a first drive arm having a first end and a second end, the drive  
5 arm being rotatable about a first axis at its first end;  
6                         ii)    a second drive arm having a first end and second end, the drive  
7 arm being rotatable about a second axis at its first end;  
8                         iii)   a first strut that is pivotally connected to the first drive arm at a  
9 first pivot joint; and  
10                    iv)    a second strut that is pivotally connected to the second drive arm  
11 at a second pivot joint, the first and second pivot joints defining a lagging axis; and  
12                    b)     a blade pivotally connected to the first strut at a first wrist joint and the  
13 second strut at a second wrist joint, the first and second wrist joints defining a leading  
14 axis remaining constantly parallel to, and horizontally displaced from, the lagging axis.

1 38. A method for transferring wafers between a plurality of positions comprising:

2 a) providing a load lock comprising:

3 i) a chamber; and

4 ii) a first transfer assembly disposed in the chamber, the first  
5 transfer assembly occupying a first horizontal plane;

6 b) disposing a wafer onto the first transfer assembly; and

7 c) actuating the first transfer assembly.

1 39. The method of claim 38 wherein actuating the first assembly comprises the  
2 steps of:

3 a) lowering the first transfer assembly along the first plane; and

4 b) raising the first transfer assembly along the first plane.

1 40. The method of claim 38 further comprising the steps of:

2 a) providing a second transfer assembly disposed in the chamber, the  
3 second transfer assembly occupying a second plane substantially perpendicular to the  
4 first plane;

5 b) positioning a wafer on the second transfer assembly; and

6 c) actuating the second transfer assembly.

1 41. The method of claim 40 wherein positioning the wafer onto the second transfer  
2 assembly comprises the steps of:

3 a) lowering the first transfer assembly along the first plane from a position  
4 above the second plane to a position coplanar with the second plane, the first transfer  
5 assembly carrying the wafer;

6 b) depositing the wafer onto the second transfer assembly;

7 c) retracting the first transfer assembly; and

8 d) raising the first transfer assembly.

1 42. The method of claim 41 wherein depositing the first transfer assembly from the  
2 wafer, the first transfer assembly comprising a pair of rods diametrically placed rods  
3 respecting the wafer and a lifting element coupled to each rod at one end, the wafer  
4 gravitationally resting on the lifting elements, comprises the steps of rotating the first  
5 transfer assembly about a central axis, such that the lifting elements are removed from  
6 one another a distance greater than the diameter of the wafer.

1 43. The method of claim 40 wherein actuating the second transfer assembly  
2 comprises the steps of:  
3 a) extending the second transfer assembly along the second plane; and  
4 b) retracting the second transfer assembly along the second plane.

1 44. A method for transferring wafers between a plurality of positions comprising:  
2 a) providing a load lock comprising:  
3 i) a chamber;  
4 ii) a first transfer assembly disposed in the chamber, the first  
5 transfer assembly moving along a vertical first plane; and  
6 iii) a second transfer assembly disposed in the chamber, the second  
7 transfer assembly moving horizontally along second plane perpendicular to the  
8 first plane;  
9 b) positioning at least two wafers onto the first transfer assembly;  
10 c) lowering the first transfer assembly  
11 d) positioning a first wafer onto the second transfer assembly;  
12 e) raising the first transfer plane;  
13 f) extending the second transfer assembly beyond the load lock, the second  
14 transfer assembly carrying the first wafer;  
15 g) retracting the second transfer assembly;  
16 h) lowering the first transfer assembly;  
17 i) removing the first wafer from the second transfer assembly; and  
18 j) raising the first transfer assembly above the second plane;

- 1 45. A method for transferring a wafer into and out of a load lock, the load lock  
2 comprising a lid and a transfer assembly, the method comprising the steps of:
- 3 a) raising the lid above a transfer plane;
  - 4 b) raising the transfer assembly above the transfer plane;
  - 5 c) positioning a wafer on the transfer assembly;
  - 6 d) lowering the transfer assembly below the transfer plane; and
  - 7 e) lowering the lid below the transfer plane.

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